

1 WHAT IS CLAIMED IS:

1. A secondary battery having a negative pole substantially made of a negative pole activating material, a positive pole substantially made of a  
5 negative pole activating material disposed while interposing a separator from said negative pole and an electrolyte or an electrolytic solution (electrolytic liquid) held between said negative pole and said positive pole, said secondary battery comprising:

10 a film which covers the surface of said negative pole and through which ions relating to battery reactions are able to pass.

2. A secondary battery according to claim 1,  
15 wherein said film has a molecular structure or apertures having gaps larger than the ions relating to said battery reactions.

3. A secondary battery according to claim 1,  
20 wherein said film has a molecular structure or apertures through which the ions relating to said battery reactions are able to pass but through which a negative pole activating material precipitated to said negative pole at the time of charge cannot pass.

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4. A secondary battery according to claim 1, wherein said film is stable such that said film does not

1 react with said electrolyte or said electrolytic  
solution and said film cannot be dissolved by the same.

5 5. A secondary battery according to claim 1,  
wherein said film has an electron donative element or a  
group.

6. A secondary battery according to claim 5,  
wherein said electron donative element of said film has  
10 an unpaired electron, a paired electron or electron d.

7. A secondary battery according to claim 5,  
wherein said electron donative group of said film has  
electron  $\pi$ .

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8. A secondary battery according to claim 5 or 6,  
wherein said electron denative element of said film has  
one or more types of elements selected from a group  
consisting of oxygen, nitrogen and sulfur.

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9. A secondary battery according to claim 1,  
wherein said film is in the form of a large ring  
compound structure.

25 10. A secondary battery according to claim 1,  
wherein said film is in the form of an aromatic ring  
structure.

1           11. A secondary battery according to claim 1,  
wherein said film is fluororesin.

          12. A secondary battery according to claim 1,  
5 wherein said film is in the form of an ether bond  
structure.

          13. A secondary battery according to claim 1,  
wherein said film has a carbonyl group.

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          14. A secondary battery according to claim 1,  
wherein said film is in the form of a structure in which  
phosphorus atoms and nitrogen atoms are alternately  
double-bonded in a phosphorus-nitrogen manner.

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          15. A secondary battery according to claim 1,  
wherein said film is made of a glass-type metal oxide.

          16. A secondary battery according to claim 1,  
20 wherein said film has a polymer structure.

          17. A secondary battery according to claim 1,  
wherein said film has a crosslinked polymer structure.

25           18. A secondary battery according to claim 1,  
wherein said film includes conductor powder dispersed  
therein.

1        19. A secondary battery according to claim 1,  
wherein said negative pole activating material is  
lithium or lithium alloy.

5        20. A secondary battery according to claim 1,  
wherein said negative pole activating material is zinc  
or zinc alloy.

10       21. A secondary battery according to claim 19,  
wherein said surface of said negative pole covered with  
said film is subjected to lipophilic treatment.

15       22. A secondary battery according to claim 20,  
wherein said surface of said negative pole covered with  
said film is subjected to hydrophilic treatment.

20       23. A secondary battery according to claim 1,  
wherein at least the surface of said separator opposing  
said negative pole is covered with the same material  
which forms said film.

25       24. A secondary battery having a negative pole  
substantially made of a negative pole activating  
material, a positive pole substantially made of a  
negative pole activating material disposed while  
interposing a separator from said negative pole and an  
electrolyte or an electrolytic solution (electrolytic

1 liquid) held between said negative pole and said  
positive pole, said secondary battery comprising:

at least a surface of said negative pole  
opposing said positive pole is treated with a reactive  
5 and gaseous material containing a nitrogen element or a  
halogen element.

25. A secondary battery according to claim 24,  
wherein said reactive and gaseous materials a plasma-  
10 type material.

26. A secondary battery according to claim 24,  
wherein said material containing nitrogen is one or more  
types of materials selected from a group consisting of  
15 nitrogen, ammonia and nitrogen trifluoride.

27. A secondary battery according to claim 24,  
wherein said material containing said halogen element  
is one or more types of materials selected from a group  
20 consisting of fluorine, chlorine, hydrogen fluoride,  
hydrogen chloride, nitrogen trifluoride and a carbon  
halide such as carbon tetrafluoride.

28. A secondary battery according to claim 24,  
25 wherein one or more types of gases selected from a group  
consisting of oxygen gas, hydrogen gas, argon gas,  
helium gas and xenon gas are added to said reactive and

1 gaseous raw material gas containing the nitrogen element  
or halogen element to treat the surface of said negative  
pole.

5           29. A secondary battery according to claim 24,  
wherein said reactive and gaseous material is a material  
in a plasma state which treats the surface of said  
lithium negative pole.

10           30. A secondary battery according to claim 24,  
wherein said negative pole activating material is  
lithium or lithium alloy.

            31. A secondary battery having a negative pole  
15 substantially made of a negative pole activating  
material, a positive pole substantially made of a  
negative pole activating material disposed while inter-  
posing a separator from said negative pole and an  
electrolyte or an electrolytic solution (electrolytic  
20 liquid) held between said negative pole and said  
positive pole, said secondary battery comprising:

            one or more types of layers selected from a  
group consisting of a conductor layer, a semiconductor  
layer and an insulating layer and disposed between said  
25 negative pole and said separator.

            32. A secondary battery according to claim 31,

1 wherein said negative pole is made of lithium, lithium  
alloy, zinc or zinc alloy.

33. A secondary battery according to claim 31,  
5 wherein said conductor layer or said semiconductor layer  
is made of one or more types of elements selected from  
a group consisting of carbon, Ni, Ti, Pt and Si.

34. A secondary battery according to claim 31,  
10 wherein said insulating layer is one or more types of  
insulators selected from a group consisting of halide,  
nitride and carbide.

35. A secondary battery according to claim 31,  
15 wherein a layer selected from a group consisting of  
said conductor layer, said semiconductor layer and said  
insulating layer is in contact with said negative pole  
activating material.

20 36. A secondary battery according to claim 31,  
wherein a layer selected from a group consisting of said  
conductor layer, said semiconductor layer and said  
insulating layer is in contact with said separator.

25 37. A secondary battery according to claim 31,  
wherein a layer selected from a group consisting of said  
conductor layer, said semiconductor layer and said

1 insulating layer covers at least the surface of said  
negative pole activating material adjacent to said  
separator.

5 38. A secondary battery according to claim 31,  
wherein a layer selected from a group consisting of said  
conductor layer, said semiconductor layer and said  
insulating layer is pressed and secured to the surface  
of said negative pole activating material.

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39. A secondary battery according to claim 31,  
wherein a layer selected from a group consisting of  
said conductor layer, said semiconductor layer and said  
insulating layer covers at least the surface of said  
15 separator adjacent to said negative pole.

40. A secondary battery according to claim 36,  
wherein a layer selected from a group consisting of said  
conductor layer, said semiconductor layer and said  
20 insulating layer is pressed and secured to said  
separator.

41. A secondary battery according to claim 31,  
wherein said conductor layer is made of carbon fiber  
25 having a specific area of  $10 \text{ m}^2/\text{g}$  and a void ratio of  
50 % or more.

1           42. A secondary battery having a negative pole  
made of a negative pole activating material and a  
positive pole made of a positive pole activating  
material and arranged in such a manner that said  
5 negative pole activating material and said positive pole  
activating material are separated from each other by a  
separator, said secondary battery comprising:

at least a multi-layer metal oxide formed  
between said positive pole and said negative pole.

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43. A secondary battery according to claim 42,  
wherein said multi-layer metal oxide contains one or  
more types of materials selected from a group consisting  
of alumina, titanium oxide, silica, selenium oxide,  
15 zirconia oxide, magnesium oxide, chrome oxide, calcium  
oxide, tin oxide, indium oxide and germanium oxide.

44. A secondary battery according to claim 42,  
wherein said multi-layer metal oxide is formed by a mold  
20 made of bimolecular film.

45. A secondary battery according to claim 44,  
wherein said bimolecular film is a compound (a  
amphipathic material) having both hydrophobic group and  
25 a hydrophilic group.

46. A secondary battery according to claim 44,

1 wherein said bimolecular film is formed in a film shape  
combining an amphipathic material and a polymer  
compound.

5 47. A secondary battery according to claim 44,  
wherein said bimolecular film is a reactant (polyion  
complex) of an ionic amphipathic material and a polymer  
electrolyte.

10 48. A secondary battery according to claim 42,  
wherein said multi-layer metal oxide is a composite of  
an organic polymer.

15 49. A secondary battery according to claim 42,  
wherein said multi-layer metal oxide is a portion of  
said separator.

20 50. A secondary battery according to claim 42,  
wherein the surface of said positive pole made of said  
positive pole activating material and opposing said  
negative pole is covered with at least a film through  
which ions relating to battery reactions are able to  
pass.

25 51. A secondary battery according to claim 42,  
wherein the surface of said negative pole made of said  
negative pole activating material and opposing said

1 positive pole is covered with at least a film through  
which ions relating to battery reactions are able to  
pass.

5 52. A secondary battery according to claim 42,  
wherein said film through which the ions relating to the  
battery reactions are able to pass is made of a multi-  
layer metal oxide prepared in a mold made of a  
bimolecular film.

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53. A secondary battery according to claim 42,  
wherein said negative pole activating material is  
lithium or lithium alloy.

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54. A secondary battery according to claim 42,  
wherein said negative pole activating material is zinc  
or zinc alloy.

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55. A secondary battery according to claim 42,  
wherein said multi-layer metal oxide is subjected to  
lipophilic treatment.

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56. A secondary battery according to claim 42,  
wherein said multi-layer metal oxide has a conductor  
member on the surface thereof which opposes said  
negative pole.

1           57. A secondary battery comprising:

          a negative pole substantially made of a negative  
pole activating material;

          a positive pole substantially made of a ~~negative~~  
5 pole activating material disposed while interposing a  
separator from said negative pole; and

          an electrolyte or an electrolytic solution  
(electrolytic liquid) held between said negative pole  
and said positive pole, wherein

10           at least the surface of said positive pole  
opposing said negative pole is covered with one or more  
layers selected from a group consisting of an insulating  
film, a semiconductor film and a composite film of an  
insulating material and a semiconductor through which  
15 ions relating to battery reactions are able to pass.

          58. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
are able to pass is a large ring compound through which  
20 the ions relating to the battery reactions are able to  
pass.

          59. A secondary battery according to claim 58,  
wherein said large ring compound is a ring compound  
25 having one or more types of structures selected from a  
group consisting of a ring polyether, a ring polyamine,  
ring polythioether, azacrown ether, ring thioether,

1 thiocrown ether, cryptand, cyclam, cyclodextrin,  
cyclofan, phthalocyanin and porphyrin compound.

60. A secondary battery according to claim 57,  
5 wherein said insulating member through which the ions  
are able to pass is a polymer of a derivative of an  
aromatic hydrocarbon.

61. A secondary battery according to claim 60,  
10 wherein said derivative of the aromatic hydrocarbon is  
one or more types of derivatives selected from a group  
consisting of naphthalene, anthracene, phenanthlene,  
naphthacene, pyrene, triphenylene, perillene, picene,  
benzopyrene, coronene and ovalene.

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62. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
are able to pass is fluoro-resin.

20 63. A secondary battery according to claim 62,  
wherein said fluoro-resin has an ether bond.

64. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
25 are able to pass is silicone resin which is an organic  
silicon compound.

1        65. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
are able to pass is a titanium polymer which is an  
organic titanium compound.

5

66. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
are able to pass is a polymer in which phosphorus atoms  
and nitrogen atoms alternately form phosphorus-nitrogen  
10 double bonds.

67. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
are able to pass is inorganic glass mainly composed of  
15 an inorganic oxide.

68. A secondary battery according to claim 67,  
wherein said inorganic glass is combined with an organic  
polymer.

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69. A secondary battery according to claim 67,  
wherein said inorganic oxide contains oxides of one or  
more elements selected from a group consisting of  
silicon, titanium, aluminum, magnesium, zirconium, lead  
25 and calcium.

70. A secondary battery according to claim 57,

1 wherein said insulating member through which the ions  
are able to pass is a carbide.

71. A secondary battery according to claim 57,  
5 wherein said insulating member through which the ions  
are able to pass is a nitride.

72. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
10 are able to pass is a halide.

73. A secondary battery according to claim 72,  
wherein said halide is a fluoride.

15 74. A secondary battery according to claim 57,  
wherein said insulating member through which the ions  
are able to pass contains one or more types of elements  
selected from a group consisting of carbon and silicon.

20 75. A secondary battery according to claim 57,  
wherein the surface of said negative pole is covered  
with a film through which ions relating to battery  
reactions are able to pass.

25 76. A secondary battery according to claim 57,  
wherein said negative pole is made of lithium or lithium  
alloy and said ions relating to the reactions are

1 lithium ions.

77. A secondary battery according to claim 57,  
wherein said negative pole is made of zinc or zinc alloy  
5 and said ions relating to the reactions are hydroxide  
ions.

78. A secondary battery comprising:  
a negative pole substantially made of a negative  
10 pole activating material;  
a positive pole substantially made of a ~~negative~~  
pole activating material disposed while interposing a  
separator from said negative pole; and  
an electrolyte or an electrolytic solution  
15 (electrolytic liquid) held between said negative pole  
and said positive pole, wherein  
said positive pole activating material is mainly  
composed of a compound of one or more types of transition  
metal having a crystal grain size of  $500 \text{ \AA}$  or less and a  
20 group 6A element.

79. A secondary battery according to claim 78,  
wherein said positive pole activating material is an  
aggregate selected from a group consisting of amorphous,  
25 microcrystal, a mixture of amorphous and microcrystal  
and a mixture of amorphous, microcrystal and multi-  
crystal.

1           80. A secondary battery according to claim 78,  
wherein said positive pole activating material contains  
hydrogen.

5           81. A secondary battery according to claim 80,  
wherein said positive pole activating material has a  
hydroxide.

10           82. A secondary battery according to claim 78,  
wherein said positive pole activating material contains  
one or more types of elements selected from a group  
consisting of lithium, carbon, magnesium, sodium,  
potassium, nitrogen, aluminum, calcium, barium, lead,  
indium, boron, silicon, tin, phosphorus, arsenic,  
15   antimony, bismuth, fluorine and chlorine.

20           83. A secondary battery according to claim 78,  
wherein said group 6A element which is the main compo-  
nent of said positive pole activating material is oxygen.

            84. A secondary battery according to claim 78,  
wherein said group 6A element which is the main component  
of said positive pole activating material is sulfur.

25           85. A secondary battery according to claim 78,  
wherein said positive pole activating material is  
applied with coating treatment with a conductor.

1        86. A secondary battery according to claim 78,  
wherein a positive pole activating material of a type in  
which conductor powder serving as the core is covered  
with a compound of said transition metal and said group  
5    6A element is used.

87. A secondary battery according to claim 78,  
wherein said positive pole activating material contains  
one or more materials selected from a group consisting  
10 of carbon material, a resin material and a metal  
material mixed thereto to form a positive pole.

88. A secondary battery according to claim 78,  
wherein said positive pole activating material is  
15 subjected to lipophilic treatment.

89. A secondary battery according to claim 88,  
wherein said lipophilic treatment is treatment using an  
organic metal compound.

20 90. A secondary battery according to claim 87,  
wherein said resin material contains one or more types  
of resins selected from a group consisting of  
fluororesin, polyethylene, polypropylene and silicon  
25 resin.

91. A secondary battery according to claim 90,

1 wherein said resin material is a resin in the form of  
liquid or molten liquid or a resin having a low melting  
point.

5 92. A secondary battery according to claim 91,  
wherein said resin is fluororesin having an ether bond.

93. A secondary battery according to claim 78,  
wherein said negative pole activating material is  
10 composed of one or more types of materials selected from  
a group consisting of lithium, lithium alloy and carbon.

94. A secondary battery according to claim 78,  
wherein the surface of said negative pole activating  
15 material of said secondary battery is covered with a  
film through which lithium ions are able to pass.

95. A secondary battery according to claim 78,  
wherein said electrolyte is composed of at least an  
20 alkali metal compound.

96. A secondary battery according to claim 78,  
wherein said electrolyte is in a state selected from a  
group consisting of a solid state, a molten liquid state  
25 dissolved in a non-water-soluble solvent and a solid-  
liquid state.

1           97. A method of manufacturing a positive pole  
activating material of a secondary battery, said method  
comprising the steps of:

              forming a compound having a crystal grain size  
5   of 500 Å or less and composed of transition metal and a  
group 6A element by using a reaction selected from a  
group consisting of a solution reaction, a gas phase  
reaction and a melting and rapid cooling reaction.

10           98. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
compound of said transition metal and said group 6A  
element is an aggregate selected from a group consisting  
of amorphous, microcrystal, a mixture of amorphous and  
15 microcrystal and a mixture of amorphous, microcrystal  
and multi-crystal.

              99. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
20 positive pole activating material is substantially  
composed of a compound of said transition metal and said  
group 6A element, the raw material of said transition  
metal element of said compound of said transition metal  
and said group 6A element being one or more types of  
25 materials selected from a group consisting of said  
transition metal, salt of said transition metal, an  
organic metal compound of said transition metal, hydride

1 of said transition metal, hydrogated material of said  
transition metal, carbonyl compound of said transition  
metal and a transition metal oxide.

5 100. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
positive pole activating material is composed of a  
compound of said transition metal and said group 6A  
element, the raw material of said group 6A element of  
10 said compound of said transition metal and said group 6A  
element being one or more types of materials selected  
from a group consisting of water, alcohol, hydride,  
hydrogated material and halide.

15 101. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
group 6A element is oxygen.

20 102. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
group 6A element is sulfur.

25 103. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
process for forming said compound of said transition  
metal and said group 6A element includes a process for  
causing hydrogen to react.

1           104. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
positive pole activating material is composed of a  
compound of said transition metal and said group 6A  
5 element and said solution reaction includes at least a  
process for forming a hydroxide of said transition metal  
by using one or more reactions selected from a group  
consisting of a reaction between a salt of said  
transition metal and alkali, a hydrolysis reaction of an  
10 organic transition metal compound and a reaction between  
said transition metal and alkali.

          105. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
15 gas phase reaction includes at least a process for  
causing gasified transition metal salt or an organic  
transition metal compound or vapor of said transition  
metal and said group 6A element or a compound of said  
group 6A element to react with each other in a gas phase  
20 or a process for decomposing transition metal salt  
containing gasified group 6A element or an organic  
transition metal compound in a gas phase so that said  
compound of said transition metal and said group 6A  
element is prepared.

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          106. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said

1    activating material is composed of a compound of said  
transition metal and said group 6A element and said  
melting and rapid cooling reaction includes at least a  
process for melting one or more types of materials  
5    selected from a group consisting of said transition  
metal and said transition metal compound to be caused to  
react with one or more types of materials selected from  
a group 6A element and said group 6A element compound  
and rapidly cooling said reactant.

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107. A method of manufacturing a positive pole  
activating material according to claim 97, wherein said  
positive pole activating material is composed of said  
transition metal and said group 6A element and at least  
15    of a process for applying supersonic vibrations is  
provided.

108. A method of manufacturing a positive pole  
activating material according to claim 99, wherein said  
20    salt of said transition metal is one or more types of  
salts selected from a group consisting of nitrate,  
carbonate, sulfate, halide, phosphate, borate, salt of  
organic acid and ammonia salt.

25    109. A method of manufacturing a positive pole  
activating material according to claim 99, wherein said  
organic transition metal compound is one or more types

1 of salts selected from a group consisting of metal  
alkoxide, acetylacetonate, salt of octylic acid and  
naphthenate.

5 110. A method of manufacturing a positive pole  
activating material according to claim 104, wherein acid  
and/or alkali is added in said hydrolysis reaction of  
said organic transition metal compound.

10 111. A method of manufacturing a positive pole  
activating material according to claim 104 further  
comprising a dehydrating reaction process.

15 112. A method of manufacturing a positive pole  
activating material according to claim 104 further  
comprising a process for causing hydrogen sulfide to  
react.

20 113. A method of manufacturing a positive pole  
activating material according to claim 105, wherein a  
solid transition metal salt or a organic transition  
metal compound is heated to be formed into vapor or  
heated to be liquid and a carrier gas is bubbled as to  
be introduced into a reaction chamber or a solution  
25 dissolved in a solvent is introduced into said reaction  
chamber while bubbling said carrier gas so that a gas  
phase reaction is caused to take place.

1        114. A method of manufacturing a positive pole  
activating material according to claim 105, wherein said  
liquid transition metal salt or said organic transition  
metal compound is heated to be formed into vapor or  
5 carrier gas is bubbled to be introduced into a reaction  
chamber so that a gas phase reaction is caused to take  
place.

115. A method of manufacturing a positive pole  
10 activating material according to claim 106, wherein a  
rapid cooling rate is  $10^1$  to  $10^8$  K per second.

116. A method of manufacturing a positive pole  
activating material according to claim 97 and made of a  
15 compound of said transition metal and said group 6A  
element further comprising at least a step of adding one  
or more types of elements selected from a group  
consisting of lithium, carbon, magnesium, sodium,  
potassium, nitrogen, aluminum, calcium, barium, lead,  
20 indium, boron, silicon, tin, phosphorus, antimony,  
bismuth, fluorine and chlorine.

117. A method of manufacturing a positive pole  
activating material according to claim 116, wherein the  
25 raw material of the additive elements to be added to  
said positive pole activating material is one or more  
types of materials selected from a group consisting of

1 said additive element, salt of said additive element,  
organic compound of said additive element, hydride of  
said additive element and hydrogated material of said  
additive element.

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118. A method of manufacturing a positive pole  
activating material according to claim 97 further  
comprising a step of mixing conductor powder to be used  
as the core of said compound of said transition metal  
10 and said group 6A element.

119. A method of manufacturing a positive pole  
activating material according to claim 97 further  
comprising a step of covering by using a conductor after  
15 said compound of said transition metal and said group 6A  
element has been prepared.

120. A method of manufacturing a positive pole  
comprising the step of:  
20 mixing one or more types or resins selected from  
a group consisting of fluorine resin, polyethylene,  
polypropylene and silicon resin into said positive pole  
activating material prepared by said manufacturing  
method according to claim 97.

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121. A method of manufacturing a positive pole  
according to claim 120, wherein said resin material is

1 liquid or solution or low melting point resin.

122. A method of manufacturing a positive pole  
according to claim 120, wherein said resin material is  
5 fluorine resin having an ether bond.

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